of this traumatic economic downturn. And, as we will see throughout this chapter, the model can also be used to shed light on more recent recessions, such as those that began in 2001 and 2008.

11-1 Explaining Fluctuations With the *IS–LM* Model

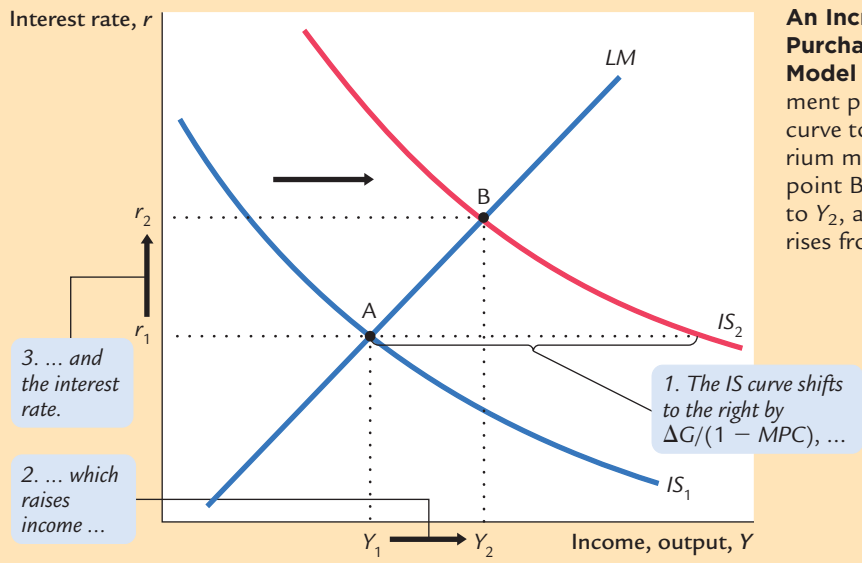
The intersection of the *IS* curve and the *LM* curve determines the level of national income. When one of these curves shifts, the short-run equilibrium of the economy changes, and national income fluctuates. In this section we examine how changes in policy and shocks to the economy can cause these curves to shift.

How Fiscal Policy Shifts the *IS* Curve and Changes the Short-Run Equilibrium

We begin by examining how changes in fiscal policy (government purchases and taxes) alter the economy's short-run equilibrium. Recall that changes in fiscal policy influence planned expenditure and thereby shift the *IS* curve. The *IS–LM* model shows how these shifts in the *IS* curve affect income and the interest rate.

Changes in Government Purchases Consider an increase in government purchases of ΔG. The government-purchases multiplier in the Keynesian cross tells us that this change in fiscal policy raises the level of income at any given interest rate by $\Delta G/(1 - MPC)$. Therefore, as Figure 11-1 shows, the *IS* curve shifts to the right

FIGURE 11-1



An Increase in Government Purchases in the *IS–LM* Model An increase in government purchases shifts the *IS* curve to the right. The equilibrium moves from point A to point B. Income rises from Y_1 to Y_2, and the interest rate rises from r_1 to r_2.

by this amount. The equilibrium of the economy moves from point A to point B. The increase in government purchases raises both income and the interest rate.

To understand fully what's happening in Figure 11-1, it helps to keep in mind the building blocks for the *IS–LM* model from the preceding chapter—the Keynesian cross and the theory of liquidity preference. Here is the story. When the government increases its purchases of goods and services, the economy's planned expenditure rises. The increase in planned expenditure stimulates the production of goods and services, which causes total income Y to rise. These effects should be familiar from the Keynesian cross.

Now consider the money market, as described by the theory of liquidity preference. Because the economy's demand for money depends on income, the rise in total income increases the quantity of money demanded at every interest rate. The supply of money has not changed, however, so higher money demand causes the equilibrium interest rate r to rise.

The higher interest rate arising in the money market, in turn, has ramifications back in the goods market. When the interest rate rises, firms cut back on their investment plans. This fall in investment partially offsets the expansionary effect of the increase in government purchases. Thus, the increase in income in response to a fiscal expansion is smaller in the *IS–LM* model than it is in the Keynesian cross (where investment is assumed to be fixed). You can see this in Figure 11-1. The horizontal shift in the *IS* curve equals the rise in equilibrium income in the Keynesian cross. This amount is larger than the increase in equilibrium income here in the *IS–LM* model. The difference is explained by the crowding out of investment due to a higher interest rate.

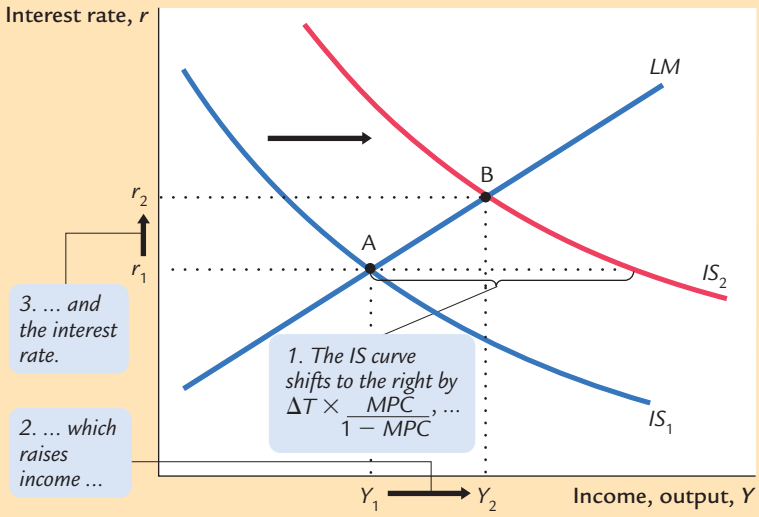
Changes in Taxes In the *IS–LM* model, changes in taxes affect the economy much the same as changes in government purchases do, except that taxes affect expenditure through consumption. Consider, for instance, a decrease in taxes of ΔT. The tax cut encourages consumers to spend more and, therefore, increases planned expenditure. The tax multiplier in the Keynesian cross tells us that this change in policy raises the level of income at any given interest rate by $\Delta T \times MPC/(1 - MPC)$. Therefore, as Figure 11-2 illustrates, the *IS* curve shifts to the right by this amount. The equilibrium of the economy moves from point A to point B. The tax cut raises both income and the interest rate. Once again, because the higher interest rate depresses investment, the increase in income is smaller in the *IS–LM* model than it is in the Keynesian cross.

How Monetary Policy Shifts the *LM* Curve and Changes the Short-Run Equilibrium

We now examine the effects of monetary policy. Recall that a change in the money supply alters the interest rate that equilibrates the money market for any given level of income and, thus, shifts the *LM* curve. The *IS–LM* model shows how a shift in the *LM* curve affects income and the interest rate.

Consider an increase in the money supply. An increase in M leads to an increase in real money balances M/P, because the price level P is fixed in the short run. The theory of liquidity preference shows that for any given level of

FIGURE 11-2

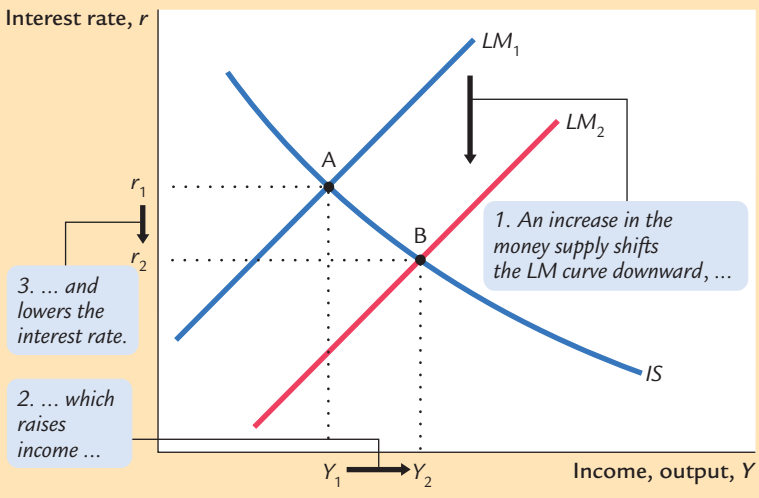


A Decrease in Taxes in the *IS–LM* Model A decrease in taxes shifts the *IS* curve to the right. The equilibrium moves from point A to point B. Income rises from Y_1 to Y_2, and the interest rate rises from r_1 to r_2.

income, an increase in real money balances leads to a lower interest rate. Therefore, the *LM* curve shifts downward, as in Figure 11-3. The equilibrium moves from point A to point B. The increase in the money supply lowers the interest rate and raises the level of income.

Once again, to tell the story that explains the economy's adjustment from point A to point B, we rely on the building blocks of the *IS–LM* model—the Keynesian cross and the theory of liquidity preference. This time, we begin with the money market, where the monetary-policy action occurs. When the Federal

FIGURE 11-3



An Increase in the Money Supply in the *IS–LM* Model An increase in the money supply shifts the *LM* curve downward. The equilibrium moves from point A to point B. Income rises from Y_1 to Y_2, and the interest rate falls from r_1 to r_2.

Reserve increases the supply of money, people have more money than they want to hold at the prevailing interest rate. As a result, they start depositing this extra money in banks or using it to buy bonds. The interest rate r then falls until people are willing to hold all the extra money that the Fed has created; this brings the money market to a new equilibrium. The lower interest rate, in turn, has ramifications for the goods market. A lower interest rate stimulates planned investment, which increases planned expenditure, production, and income Y.

Thus, the *IS–LM* model shows that monetary policy influences income by changing the interest rate. This conclusion sheds light on our analysis of monetary policy in Chapter 9. In that chapter we showed that in the short run, when prices are sticky, an expansion in the money supply raises income. But we did not discuss *how* a monetary expansion induces greater spending on goods and services—a process called the **monetary transmission mechanism.** The *IS–LM* model shows an important part of that mechanism: *an increase in the money supply lowers the interest rate, which stimulates investment and thereby expands the demand for goods and services.* The next chapter shows that in open economies, the exchange rate also has a role in the monetary transmission mechanism; for large economies such as that of the United States, however, the interest rate has the leading role.

The Interaction Between Monetary and Fiscal Policy

When analyzing any change in monetary or fiscal policy, it is important to keep in mind that the policymakers who control these policy tools are aware of what the other policymakers are doing. A change in one policy, therefore, may influence the other, and this interdependence may alter the impact of a policy change.

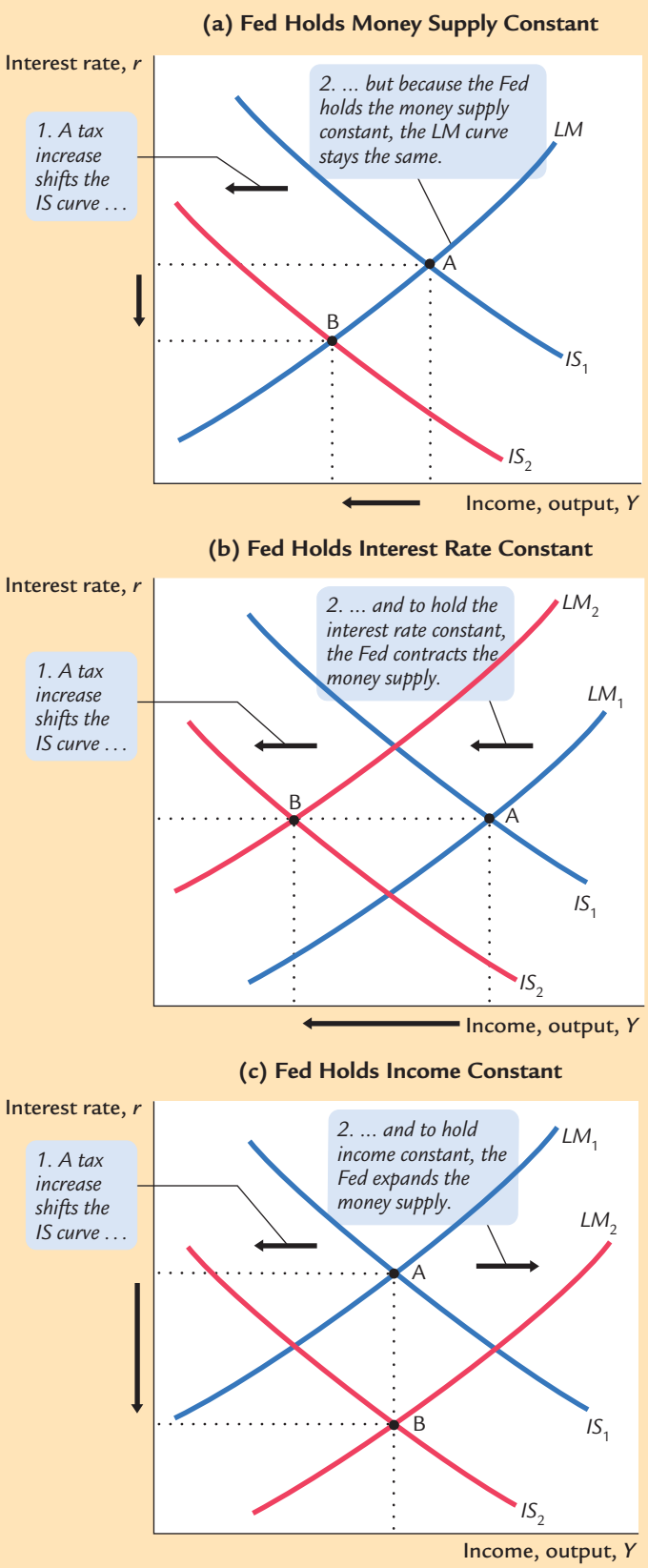
For example, suppose Congress raises taxes. What effect will this policy have on the economy? According to the *IS–LM* model, the answer depends on how the Fed responds to the tax increase.

Figure 11-4 shows three of the many possible outcomes. In panel (a), the Fed holds the money supply constant. The tax increase shifts the *IS* curve to the left. Income falls (because higher taxes reduce consumer spending), and the interest rate falls (because lower income reduces the demand for money). The fall in income indicates that the tax hike causes a recession.

In panel (b), the Fed wants to hold the interest rate constant. In this case, when the tax increase shifts the *IS* curve to the left, the Fed must decrease the money supply to keep the interest rate at its original level. This fall in the money supply shifts the *LM* curve upward. The interest rate does not fall, but income falls by a larger amount than if the Fed had held the money supply constant. Whereas in panel (a) the lower interest rate stimulated investment and partially offset the contractionary effect of the tax hike, in panel (b) the Fed deepens the recession by keeping the interest rate high.

In panel (c), the Fed wants to prevent the tax increase from lowering income. It must, therefore, raise the money supply and shift the *LM* curve downward enough to offset the shift in the *IS* curve. In this case, the tax increase does not cause a recession, but it does cause a large fall in the interest rate. Although the level of income is not changed, the combination of a tax increase and a monetary expansion does change the allocation of the economy's resources. The

FIGURE 11-4



The Response of the Economy to a Tax Increase How the economy responds to a tax increase depends on how the central bank responds. In panel (a) the Fed holds the money supply constant. In panel (b) the Fed holds the interest rate constant by reducing the money supply. In panel (c) the Fed holds the level of income constant by raising the money supply. In each case, the economy moves from point A to point B.

higher taxes depress consumption, while the lower interest rate stimulates investment. Income is not affected because these two effects exactly balance.

From this example we can see that the impact of a change in fiscal policy depends on the policy the Fed pursues—that is, on whether it holds the money supply, the interest rate, or the level of income constant. More generally, whenever analyzing a change in one policy, we must make an assumption about its effect on the other policy. The most appropriate assumption depends on the case at hand and the many political considerations that lie behind economic policymaking.

CASE STUDY

Policy Analysis With Macroeconometric Models

The *IS–LM* model shows how monetary and fiscal policy influence the equilibrium level of income. The predictions of the model, however, are qualitative, not quantitative. The *IS–LM* model shows that increases in government purchases raise GDP and that increases in taxes lower GDP. But when economists analyze specific policy proposals, they need to know not only the direction of the effect but also the size. For example, if Congress increases taxes by $100 billion and if monetary policy is not altered, how much will GDP fall? To answer this question, economists need to go beyond the graphical representation of the *IS–LM* model.

Macroeconometric models of the economy provide one way to evaluate policy proposals. A *macroeconometric model* is a model that describes the economy quantitatively, rather than just qualitatively. Many of these models are essentially more complicated and more realistic versions of our *IS–LM* model. The economists who build macroeconometric models use historical data to estimate parameters such as the marginal propensity to consume, the sensitivity of investment to the interest rate, and the sensitivity of money demand to the interest rate. Once a model is built, economists can simulate the effects of alternative policies with the help of a computer.

Table 11-1 shows the fiscal-policy multipliers implied by one widely used macroeconometric model, the Data Resources Incorporated (DRI) model, named for the economic forecasting firm that developed it. The multipliers are given for two assumptions about how the Fed might respond to changes in fiscal policy.

One assumption about monetary policy is that the Fed keeps the nominal interest rate constant. That is, when fiscal policy shifts the *IS* curve to the right or to the left, the Fed adjusts the money supply to shift the *LM* curve in the same direction. Because there is no crowding out of investment due to a changing interest rate, the fiscal-policy multipliers are similar to those from the Keynesian cross. The DRI model indicates that, in this case, the government-purchases multiplier is 1.93, and the tax multiplier is −1.19. That is, a $100 billion increase in government purchases raises GDP by $193 billion, and a $100 billion increase in taxes lowers GDP by $119 billion.

The second assumption about monetary policy is that the Fed keeps the money supply constant so that the *LM* curve does not shift. In this case, the interest rate rises, and investment is crowded out, so the multipliers are much smaller. The government-purchases multiplier is only 0.60, and the tax multiplier is only −0.26.

The *IS** curve slopes downward because a higher exchange rate reduces net exports, which in turn lowers aggregate income. To show how this works, the other panels of Figure 12-1 combine the net-exports schedule and the Keynesian cross to derive the *IS** curve. In panel (a), an increase in the exchange rate from e_1 to e_2 lowers net exports from $NX(e_1)$ to $NX(e_2)$. In panel (b), the reduction in net exports shifts the planned-expenditure schedule downward and thus lowers income from Y_1 to Y_2. The *IS** curve summarizes this relationship between the exchange rate e and income Y.

The Money Market and the *LM** Curve

The Mundell–Fleming model represents the money market with an equation that should be familiar from the *IS–LM* model:

$$M/P = L(r, Y).$$

This equation states that the supply of real money balances M/P equals the demand $L(r, Y)$. The demand for real balances depends negatively on the interest rate and positively on income Y. The money supply M is an exogenous variable controlled by the central bank, and because the Mundell–Fleming model is designed to analyze short-run fluctuations, the price level P is also assumed to be exogenously fixed.

Once again, we add the assumption that the domestic interest rate equals the world interest rate, so $r = r^*$:

$$M/P = L(r^*, Y).$$

Let's call this the *LM** equation. We can represent it graphically with a vertical line, as in panel (b) of Figure 12-2. The *LM** curve is vertical because the exchange rate does not enter into the *LM** equation. Given the world interest rate, the *LM** equation determines aggregate income, regardless of the exchange rate. Figure 12-2 shows how the *LM** curve arises from the world interest rate and the *LM* curve, which relates the interest rate and income.

Putting the Pieces Together

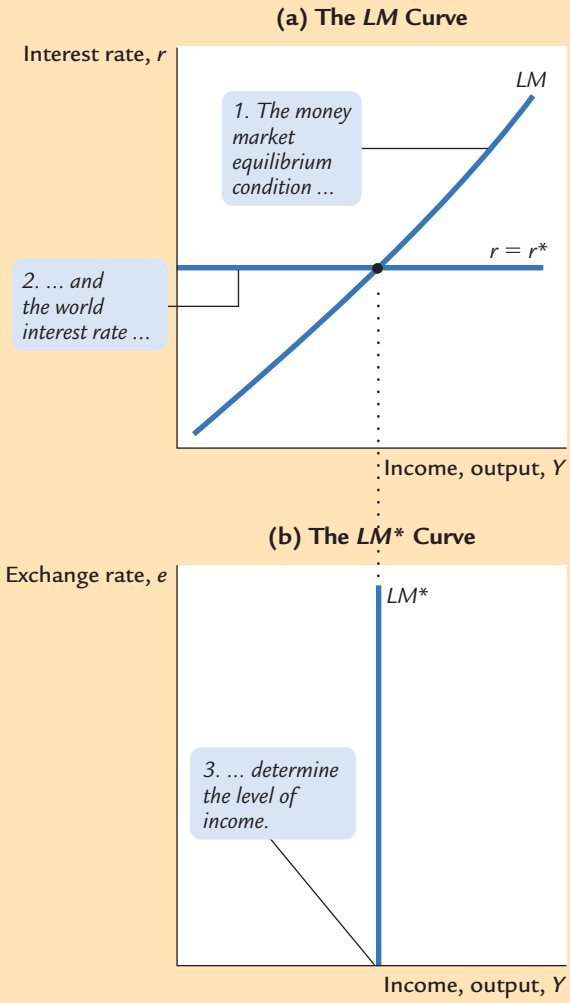
According to the Mundell–Fleming model, a small open economy with perfect capital mobility can be described by two equations:

$$Y = C(Y - T) + I(r^*) + G + NX(e) \qquad IS^*,$$

$$M/P = L(r^*, Y) \qquad LM^*.$$

The first equation describes equilibrium in the goods market; the second describes equilibrium in the money market. The exogenous variables are

FIGURE 12-2

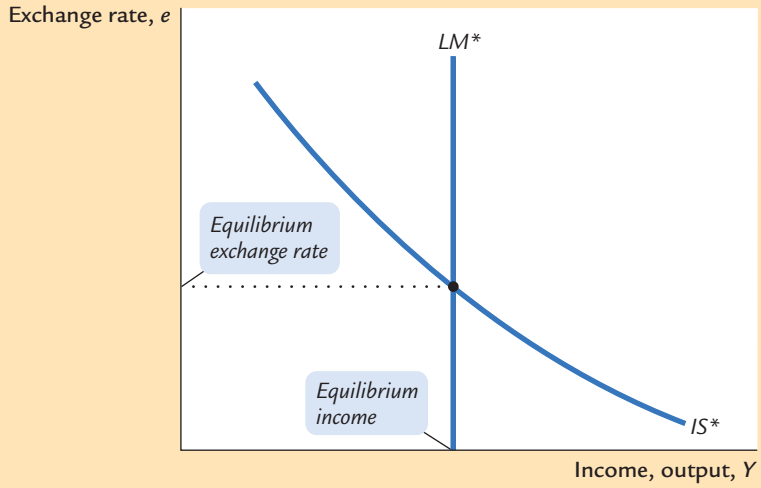


The *LM Curve** Panel (a) shows the standard *LM* curve [which graphs the equation $M/P = L(r, Y)$] together with a horizontal line representing the world interest rate r^*. The intersection of these two curves determines the level of income, regardless of the exchange rate. Therefore, as panel (b) shows, the *LM** curve is vertical.

fiscal policy G and T, monetary policy M, the price level P, and the world interest rate r^*. The endogenous variables are income Y and the exchange rate e.

Figure 12-3 illustrates these two relationships. The equilibrium for the economy is found where the *IS** curve and the *LM** curve intersect. This intersection shows the exchange rate and the level of income at which the goods market and the money market are both in equilibrium. With this diagram, we can use the Mundell–Fleming model to show how aggregate income Y and the exchange rate e respond to changes in policy.

FIGURE 12-3



The Mundell–Fleming Model This graph of the Mundell–Fleming model plots the goods-market equilibrium condition *IS** and the money market equilibrium condition *LM**. Both curves are drawn holding the interest rate constant at the world interest rate. The intersection of these two curves shows the level of income and the exchange rate that satisfy equilibrium both in the goods market and in the money market.

12-2 The Small Open Economy Under Floating Exchange Rates

Before analyzing the impact of policies in an open economy, we must specify the international monetary system in which the country has chosen to operate. That is, we must consider how people engaged in international trade and finance can convert the currency of one country into the currency of another.

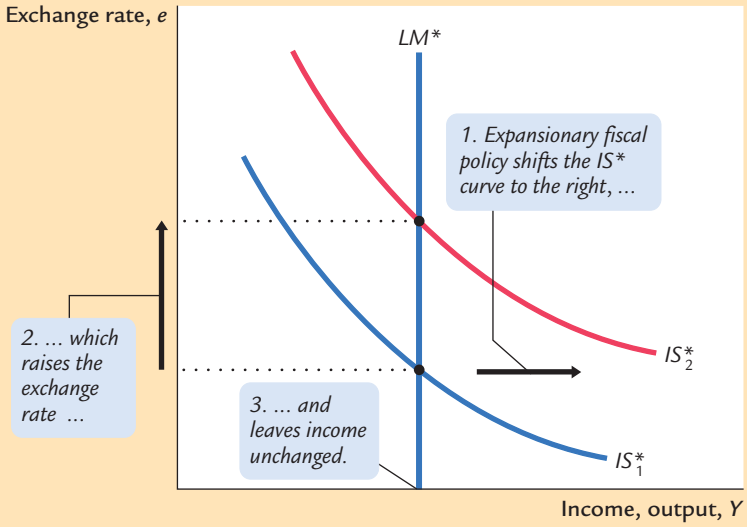
We start with the system relevant for most major economies today: **floating exchange rates.** Under a system of floating exchange rates, the exchange rate is set by market forces and is allowed to fluctuate in response to changing economic conditions. In this case, the exchange rate e adjusts to achieve simultaneous equilibrium in the goods market and the money market. When something happens to change that equilibrium, the exchange rate is allowed to move to a new equilibrium value.

Let's now consider three policies that can change the equilibrium: fiscal policy, monetary policy, and trade policy. Our goal is to use the Mundell–Fleming model to show the impact of policy changes and to understand the economic forces at work as the economy moves from one equilibrium to another.

Fiscal Policy

Suppose that the government stimulates domestic spending by increasing government purchases or by cutting taxes. Because such expansionary fiscal policy increases planned expenditure, it shifts the *IS** curve to the right, as in Figure 12-4. As a result, the exchange rate appreciates, while the level of income remains the same.

FIGURE 12-4



A Fiscal Expansion Under Floating Exchange Rates An increase in government purchases or a decrease in taxes shifts the *IS** curve to the right. This raises the exchange rate but has no effect on income.

Notice that fiscal policy has very different effects in a small open economy than it does in a closed economy. In the closed-economy *IS–LM* model, a fiscal expansion raises income, whereas in a small open economy with a floating exchange rate, a fiscal expansion leaves income at the same level. Mechanically, the difference arises because the *LM** curve is vertical, while the *LM* curve we used to study a closed economy is upward sloping. But this explanation is not very satisfying. What are the economic forces that lie behind the different outcomes? To answer this question, we must think through what is happening to the international flow of capital and the implications of these capital flows for the domestic economy.

The interest rate and the exchange rate are the key variables in the story. When income rises in a closed economy, the interest rate rises, because higher income increases the demand for money. That is not possible in a small open economy because, as soon as the interest rate starts to rise above the world interest rate r^*, capital quickly flows in from abroad to take advantage of the higher return. As this capital inflow pushes the interest rate back to r^*, it also has another effect: because foreign investors need to buy the domestic currency to invest in the domestic economy, the capital inflow increases the demand for the domestic currency in the market for foreign-currency exchange, bidding up the value of the domestic currency. The appreciation of the domestic currency makes domestic goods expensive relative to foreign goods, reducing net exports. The fall in net exports exactly offsets the effects of the expansionary fiscal policy on income.

Why is the fall in net exports so great that it renders fiscal policy powerless to influence income? To answer this question, consider the equation that describes the money market:

$$M/P = L(r, Y).$$

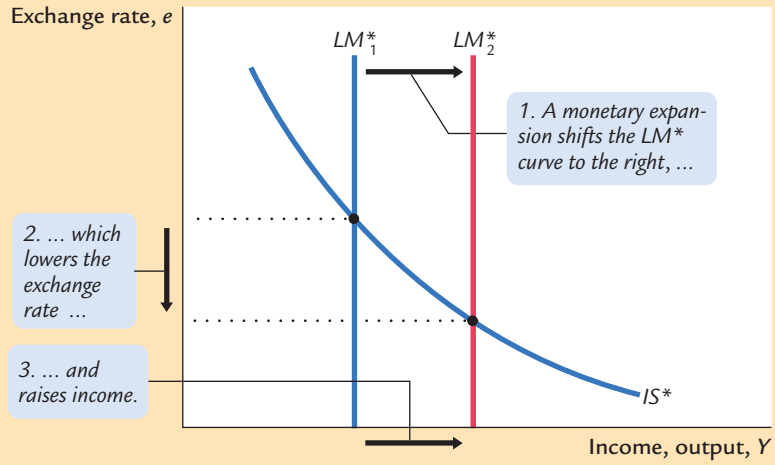
In both closed and open economies, the quantity of real money balances supplied M/P is fixed by the central bank (which sets M) and the assumption of sticky prices (which fixes P). The quantity demanded (determined by r and Y) must equal this fixed supply. In a closed economy, a fiscal expansion causes the equilibrium interest rate to rise. This increase in the interest rate (which reduces the quantity of money demanded) implies an increase in equilibrium income (which raises the quantity of money demanded); these two effects together maintain equilibrium in the money market. By contrast, in a small open economy, r is fixed at r^*, so there is only one level of income that can satisfy this equation, and this level of income does not change when fiscal policy changes. Thus, when the government increases spending or cuts taxes, the appreciation of the currency and the fall in net exports must be large enough to offset fully the expansionary effect of the policy on income.

Monetary Policy

Suppose now that the central bank increases the money supply. Because the price level is assumed to be fixed, the increase in the money supply means an increase in real money balances. The increase in real balances shifts the LM^* curve to the right, as in Figure 12-5. Hence, an increase in the money supply raises income and lowers the exchange rate.

Although monetary policy influences income in an open economy, as it does in a closed economy, the monetary transmission mechanism is different. Recall that in a closed economy an increase in the money supply increases spending because it lowers the interest rate and stimulates investment. In a small open economy, this channel of monetary transmission is not available because the interest rate is fixed by the world interest rate. So how does monetary policy

FIGURE 12-5



A Monetary Expansion Under Floating Exchange Rates An increase in the money supply shifts the LM^* curve to the right, lowering the exchange rate and raising income.

influence spending? To answer this question, we once again need to think about the international flow of capital and its implications for the domestic economy.

The interest rate and the exchange rate are again the key variables. As soon as an increase in the money supply starts putting downward pressure on the domestic interest rate, capital flows out of the economy, as investors seek a higher return elsewhere. This capital outflow prevents the domestic interest rate from falling below the world interest rate r^*. It also has another effect: because investing abroad requires converting domestic currency into foreign currency, the capital outflow increases the supply of the domestic currency in the market for foreign-currency exchange, causing the domestic currency to depreciate in value. This depreciation makes domestic goods inexpensive relative to foreign goods, stimulating net exports and thus total income. Hence, in a small open economy, monetary policy influences income by altering the exchange rate rather than the interest rate.

Trade Policy

Suppose that the government reduces the demand for imported goods by imposing an import quota or a tariff. What happens to aggregate income and the exchange rate? How does the economy reach its new equilibrium?

Because net exports equal exports minus imports, a reduction in imports means an increase in net exports. That is, the net-exports schedule shifts to the right, as in Figure 12-6. This shift in the net-exports schedule increases planned expenditure and thus moves the IS^* curve to the right. Because the LM^* curve is vertical, the trade restriction raises the exchange rate but does not affect income.

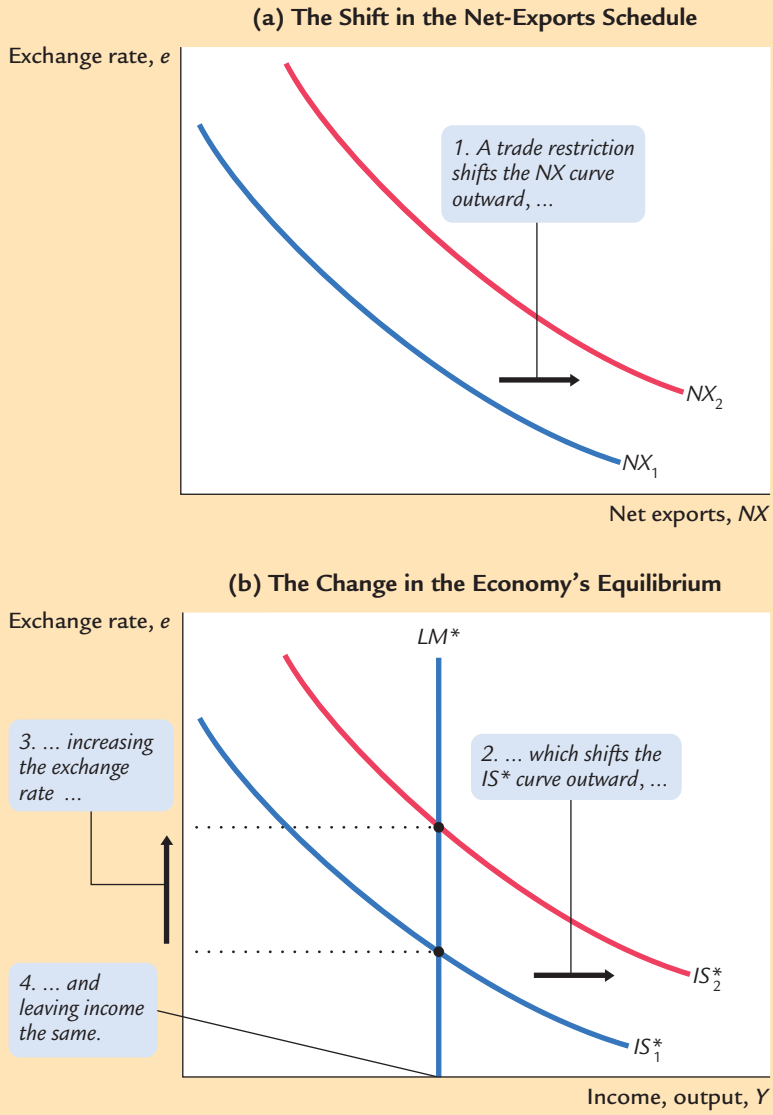
The economic forces behind this transition are similar to the case of expansionary fiscal policy. Because net exports are a component of GDP, the rightward shift in the net-exports schedule, other things equal, puts upward pressure on income Y; an increase in Y, in turn, increases money demand and puts upward pressure on the interest rate r. Foreign capital quickly responds by flowing into the domestic economy, pushing the interest rate back to the world interest rate r^* and causing the domestic currency to appreciate in value. Finally, the appreciation of the currency makes domestic goods more expensive relative to foreign goods, which decreases net exports NX and returns income Y to its initial level.

Often a stated goal of policies to restrict trade is to alter the trade balance NX. Yet, as we first saw in Chapter 5, such policies do not necessarily have that effect. The same conclusion holds in the Mundell–Fleming model under floating exchange rates. Recall that

$$NX(e) = Y - C(Y - T) - I(r^*) - G.$$

Because a trade restriction does not affect income, consumption, investment, or government purchases, it does not affect the trade balance. Although the shift in the net-exports schedule tends to raise NX, the increase in the exchange rate reduces NX by the same amount. The overall effect is simply *less trade.* The domestic economy imports less than it did before the trade restriction, but it exports less as well.

FIGURE 12-6



A Trade Restriction Under Floating Exchange Rates A tariff or an import quota shifts the net-exports schedule in panel (a) to the right. As a result, the *IS** curve in panel (b) shifts to the right, raising the exchange rate and leaving income unchanged.

12-3 The Small Open Economy Under Fixed Exchange Rates

We now turn to the second type of exchange-rate system: **fixed exchange rates.** Under a fixed exchange rate, the central bank announces a value for the exchange rate and stands ready to buy and sell the domestic currency to keep the exchange rate at its announced level. In the 1950s and 1960s, most of the world's major economies, including that of the United States, operated within

the Bretton Woods system—an international monetary system under which most governments agreed to fix exchange rates. The world abandoned this system in the early 1970s, and most exchange rates were allowed to float. Yet fixed exchange rates are not merely of historical interest. More recently, China fixed the value of its currency against the U.S. dollar—a policy that, as we will see, was a source of some tension between the two countries.

In this section we discuss how such a system works, and we examine the impact of economic policies on an economy with a fixed exchange rate. Later in the chapter we examine the pros and cons of fixed exchange rates.

How a Fixed-Exchange-Rate System Works

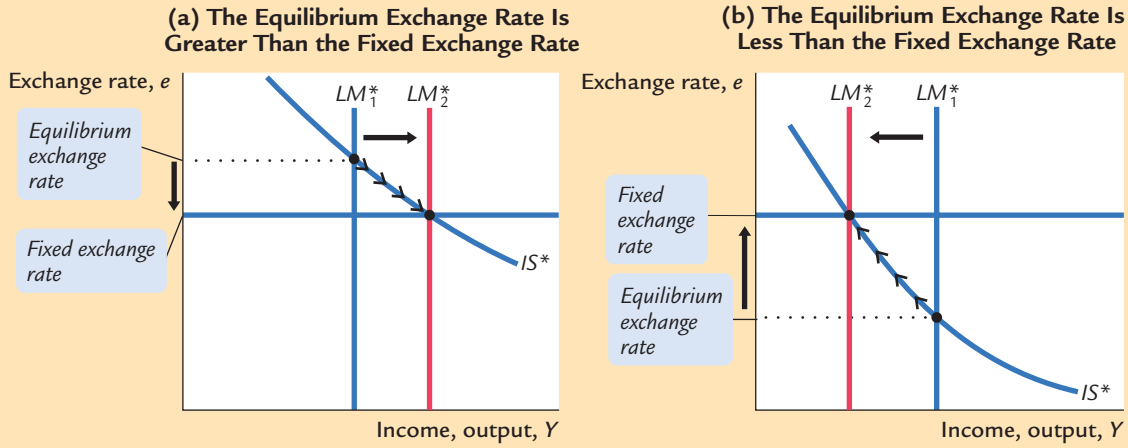
Under a system of fixed exchange rates, a central bank stands ready to buy or sell the domestic currency for foreign currencies at a predetermined price. For example, suppose the Fed announced that it was going to fix the exchange rate at 100 yen per dollar. It would then stand ready to give $1 in exchange for 100 yen or to give 100 yen in exchange for $1. To carry out this policy, the Fed would need a reserve of dollars (which it can print) and a reserve of yen (which it must have purchased previously).

A fixed exchange rate dedicates a country's monetary policy to the single goal of keeping the exchange rate at the announced level. In other words, the essence of a fixed-exchange-rate system is the commitment of the central bank to allow the money supply to adjust to whatever level will ensure that the equilibrium exchange rate in the market for foreign-currency exchange equals the announced exchange rate. Moreover, as long as the central bank stands ready to buy or sell foreign currency at the fixed exchange rate, the money supply adjusts automatically to the necessary level.

To see how fixing the exchange rate determines the money supply, consider the following example. Suppose the Fed announces that it will fix the exchange rate at 100 yen per dollar, but, in the current equilibrium with the current money supply, the market exchange rate is 150 yen per dollar. This situation is illustrated in panel (a) of Figure 12-7. Notice that there is a profit opportunity: an arbitrageur could buy 300 yen in the foreign-exchange market for $2 and then sell the yen to the Fed for $3, making a $1 profit. When the Fed buys these yen from the arbitrageur, the dollars it pays for them automatically increase the money supply. The rise in the money supply shifts the LM^* curve to the right, lowering the equilibrium exchange rate. In this way, the money supply continues to rise until the equilibrium exchange rate falls to the announced level.

Conversely, suppose that when the Fed announces that it will fix the exchange rate at 100 yen per dollar, the equilibrium has a market exchange rate of 50 yen per dollar. Panel (b) of Figure 12-7 shows this situation. In this case, an arbitrageur could make a profit by buying 100 yen from the Fed for $1 and then selling the yen in the marketplace for $2. When the Fed sells these yen, the $1 it receives automatically reduces the money supply. The fall in the money supply shifts the LM^* curve to the left, raising the equilibrium exchange rate. The money supply continues to fall until the equilibrium exchange rate rises to the announced level.

FIGURE 12-7



How a Fixed Exchange Rate Governs the Money Supply In panel (a), the equilibrium exchange rate initially exceeds the fixed level. Arbitrageurs will buy foreign currency in foreign-exchange markets and sell it to the Fed for a profit. This process automatically increases the money supply, shifting the *LM** curve to the right and lowering the exchange rate. In panel (b), the equilibrium exchange rate is initially below the fixed level. Arbitrageurs will buy dollars in foreign-exchange markets and use them to buy foreign currency from the Fed. This process automatically reduces the money supply, shifting the *LM** curve to the left and raising the exchange rate.

It is important to understand that this exchange-rate system fixes the *nominal* exchange rate. Whether it also fixes the real exchange rate depends on the time horizon under consideration. If prices are flexible, as they are in the long run, then the real exchange rate can change even while the nominal exchange rate is fixed. Therefore, in the long run described in Chapter 5, a policy to fix the nominal exchange rate would not influence any real variable, including the real exchange rate. A fixed nominal exchange rate would influence only the money supply and the price level. Yet in the short run described by the Mundell–Fleming model, prices are fixed, so a fixed nominal exchange rate implies a fixed real exchange rate as well.

CASE STUDY

The International Gold Standard

During the late nineteenth and early twentieth centuries, most of the world's major economies operated under the gold standard. Each country maintained a reserve of gold and agreed to exchange one unit of its currency for a specified amount of gold. Through the gold standard, the world's economies maintained a system of fixed exchange rates.

APPENDIX

A Short-Run Model of the Large Open Economy

When analyzing policies in an economy such as that of the United States, we need to combine the closed-economy logic of the *IS–LM* model and the small-open-economy logic of the Mundell–Fleming model. This appendix presents a model for the intermediate case of a large open economy.

As we discussed in the appendix to Chapter 5, a large open economy differs from a small open economy because its interest rate is not fixed by world financial markets. In a large open economy, we must consider the relationship between the interest rate and the flow of capital abroad. The net capital outflow is the amount that domestic investors lend abroad minus the amount that foreign investors lend here. As the domestic interest rate falls, domestic investors find foreign lending more attractive, and foreign investors find lending here less attractive. Thus, the net capital outflow is negatively related to the interest rate. Here we add this relationship to our short-run model of national income.

The three equations of the model are

$$Y = C(Y - T) + I(r) + G + NX(e),$$

$$M/P = L(r, Y),$$

$$NX(e) = CF(r).$$

The first two equations are the same as those used in the Mundell–Fleming model of this chapter. The third equation, taken from the appendix to Chapter 5, states that the trade balance NX equals the net capital outflow CF, which in turn depends on the domestic interest rate.

To see what this model implies, substitute the third equation into the first, so the model becomes

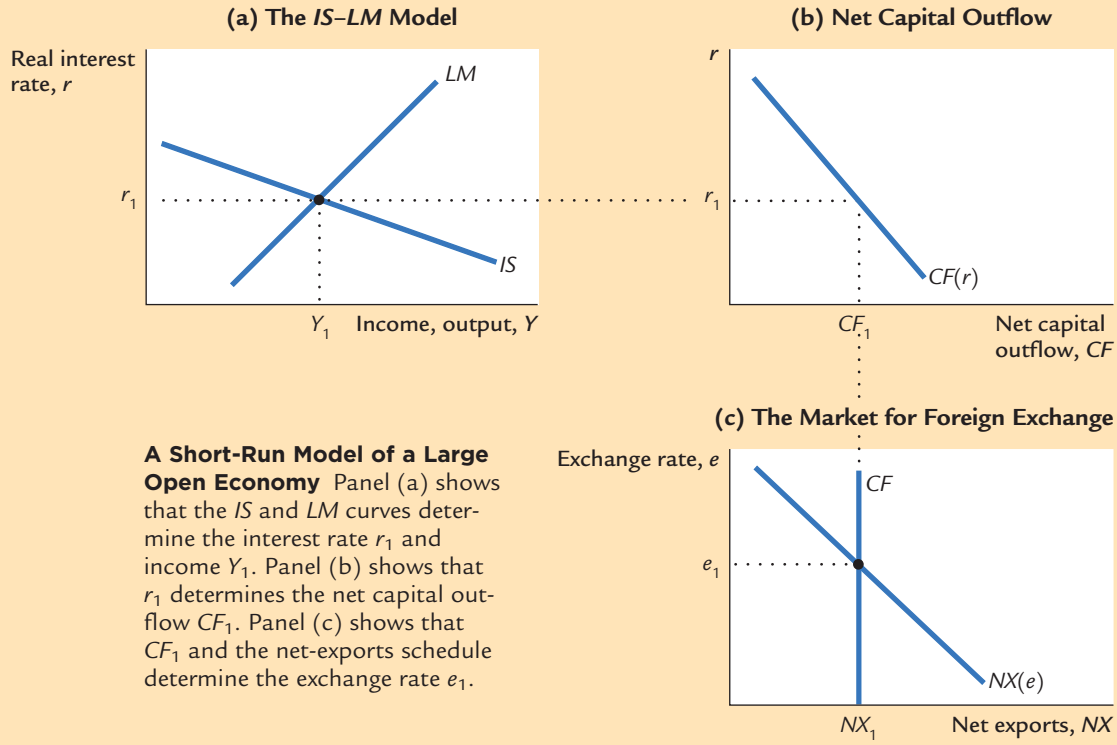
$$Y = C(Y - T) + I(r) + G + CF(r) \qquad IS,$$

$$M/P = L(r, Y) \qquad LM.$$

These two equations are much like the two equations of the closed-economy *IS–LM* model. The only difference is that expenditure now depends on the interest rate for two reasons. As before, a higher interest rate reduces investment. But now, a higher interest rate also reduces the net capital outflow and thus lowers net exports.

To analyze this model, we can use the three graphs in Figure 12-15. Panel (a) shows the *IS–LM* diagram. As in the closed-economy model in Chapters 10 and 11, the interest rate r is on the vertical axis, and income Y is on the horizontal

FIGURE 12-15



A Short-Run Model of a Large Open Economy Panel (a) shows that the *IS* and *LM* curves determine the interest rate r_1 and income Y_1. Panel (b) shows that r_1 determines the net capital outflow CF_1. Panel (c) shows that CF_1 and the net-exports schedule determine the exchange rate e_1.

axis. The *IS* and *LM* curves together determine the equilibrium level of income and the equilibrium interest rate.

The new net-capital-outflow term in the *IS* equation, $CF(r)$, makes this *IS* curve flatter than it would be in a closed economy. The more responsive international capital flows are to the interest rate, the flatter the *IS* curve is. You might recall from the Chapter 5 appendix that the small open economy represents the extreme case in which the net capital outflow is infinitely elastic at the world interest rate. In this extreme case, the *IS* curve is completely flat. Hence, a small open economy would be depicted in this figure with a horizontal *IS* curve.

Panels (b) and (c) show how the equilibrium from the *IS*–*LM* model determines the net capital outflow, the trade balance, and the exchange rate. In panel (b) we see that the interest rate determines the net capital outflow. This curve slopes downward because a higher interest rate discourages domestic investors from lending abroad and encourages foreign investors to lend here. In panel (c) we see that the exchange rate adjusts to ensure that net exports of goods and services equal the net capital outflow.

Now let's use this model to examine the impact of various policies. We assume that the economy has a floating exchange rate, because this assumption is correct for most large open economies such as that of the United States.

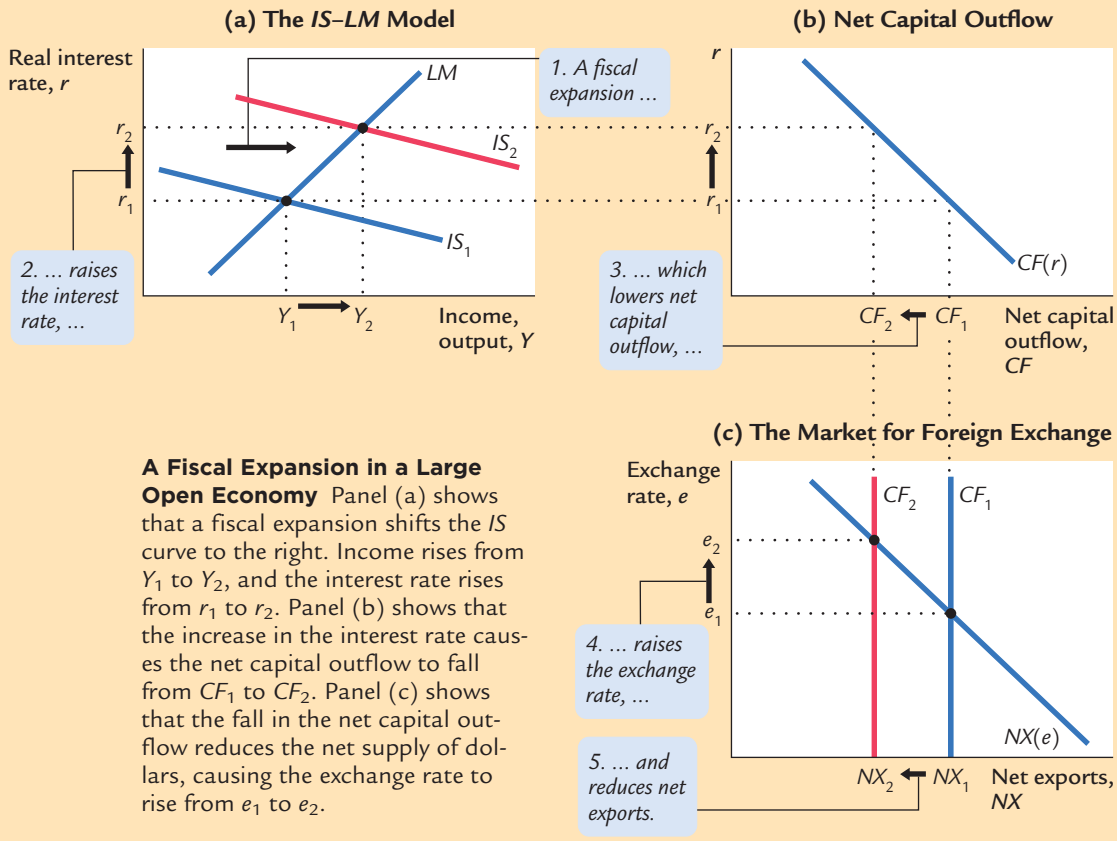
Fiscal Policy

Figure 12-16 examines the impact of a fiscal expansion. An increase in government purchases or a cut in taxes shifts the *IS* curve to the right. As panel (a) illustrates, this shift in the *IS* curve leads to an increase in the level of income and an increase in the interest rate. These two effects are similar to those in a closed economy.

Yet, in the large open economy, the higher interest rate reduces the net capital outflow, as in panel (b). The fall in the net capital outflow reduces the supply of dollars in the market for foreign exchange. The exchange rate appreciates, as in panel (c). Because domestic goods become more expensive relative to foreign goods, net exports fall.

Figure 12-16 shows that a fiscal expansion does raise income in the large open economy, unlike in a small open economy under a floating exchange rate. The impact on income, however, is smaller than in a closed economy. In a closed economy, the expansionary impact of fiscal policy is partially offset by the crowding out of investment: as the interest rate rises, investment falls, reducing

FIGURE 12-16



A Fiscal Expansion in a Large Open Economy Panel (a) shows that a fiscal expansion shifts the *IS* curve to the right. Income rises from Y_1 to Y_2, and the interest rate rises from r_1 to r_2. Panel (b) shows that the increase in the interest rate causes the net capital outflow to fall from CF_1 to CF_2. Panel (c) shows that the fall in the net capital outflow reduces the net supply of dollars, causing the exchange rate to rise from e_1 to e_2.

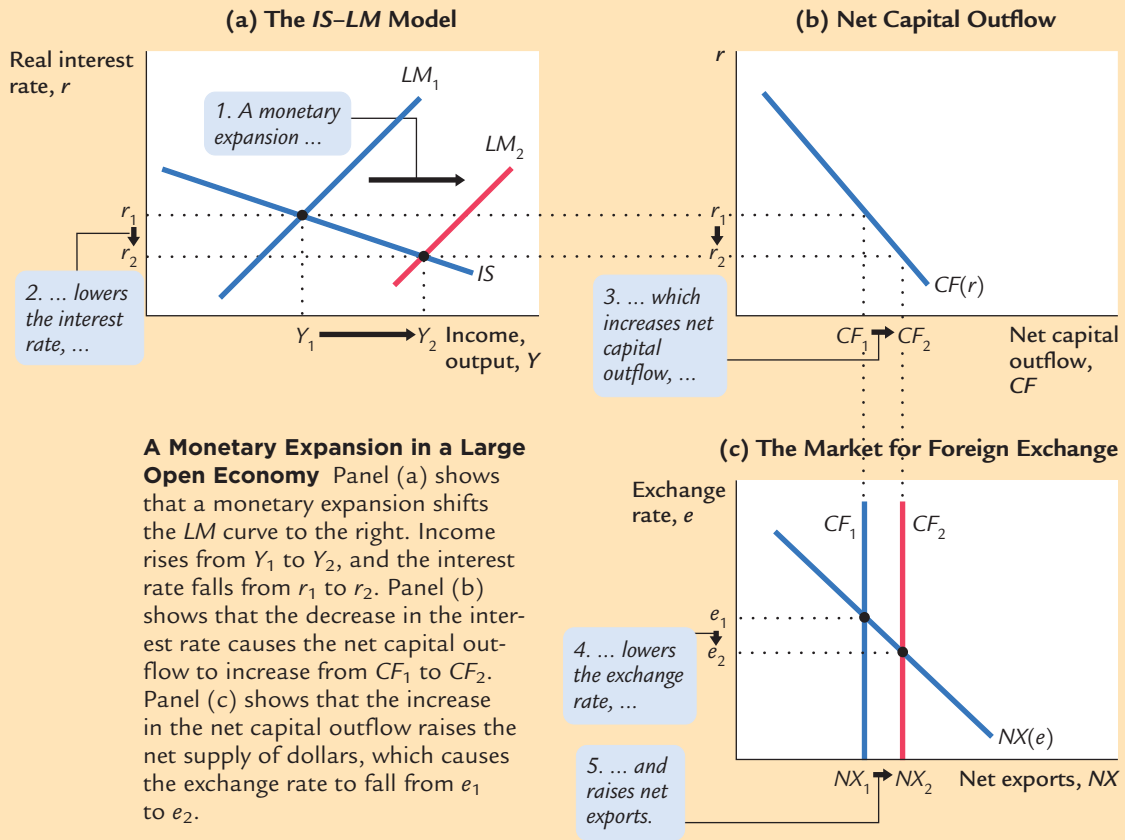
the fiscal-policy multipliers. In a large open economy, there is yet another offsetting factor: as the interest rate rises, the net capital outflow falls, the currency appreciates in the foreign-exchange market, and net exports fall. Together these effects are not large enough to make fiscal policy powerless, as it is in a small open economy, but they do reduce the impact of fiscal policy.

Monetary Policy

Figure 12-17 examines the effect of a monetary expansion. An increase in the money supply shifts the *LM* curve to the right, as in panel (a). The level of income rises, and the interest rate falls. Once again, these effects are similar to those in a closed economy.

Yet, as panel (b) shows, the lower interest rate leads to a higher net capital outflow. The increase in *CF* raises the supply of dollars in the market for foreign exchange. The exchange rate falls, as in panel (c). As domestic goods become cheaper relative to foreign goods, net exports rise.

FIGURE 12-17



A Monetary Expansion in a Large Open Economy Panel (a) shows that a monetary expansion shifts the *LM* curve to the right. Income rises from Y_1 to Y_2, and the interest rate falls from r_1 to r_2. Panel (b) shows that the decrease in the interest rate causes the net capital outflow to increase from CF_1 to CF_2. Panel (c) shows that the increase in the net capital outflow raises the net supply of dollars, which causes the exchange rate to fall from e_1 to e_2.

We can now see that the monetary transmission mechanism works through two channels in a large open economy. As in a closed economy, a monetary expansion lowers the interest rate, which stimulates investment. As in a small open economy, a monetary expansion causes the currency to depreciate in the market for foreign exchange, which stimulates net exports. Both effects result in a higher level of aggregate income.

A Rule of Thumb

This model of the large open economy describes well the U.S. economy today. Yet it is somewhat more complicated and cumbersome than the model of the closed economy we studied in Chapters 10 and 11 and the model of the small open economy we developed in this chapter. Fortunately, there is a useful rule of thumb to help you determine how policies influence a large open economy without remembering all the details of the model: *The large open economy is an average of the closed economy and the small open economy. To find how any policy will affect any variable, find the answer in the two extreme cases and take an average.*

For example, how does a monetary contraction affect the interest rate and investment in the short run? In a closed economy, the interest rate rises, and investment falls. In a small open economy, neither the interest rate nor investment changes. The effect in the large open economy is an average of these two cases: a monetary contraction raises the interest rate and reduces investment, but only somewhat. The fall in the net capital outflow mitigates the rise in the interest rate and the fall in investment that would occur in a closed economy. But unlike in a small open economy, the international flow of capital is not so strong as to negate fully these effects.

This rule of thumb makes the simple models all the more valuable. Although they do not describe perfectly the world in which we live, they do provide a useful guide to the effects of economic policy.

MORE PROBLEMS AND APPLICATIONS

1. Imagine that you run the central bank in a large open economy. Your goal is to stabilize income, and you adjust the money supply accordingly. Under your policy, what happens to the money supply, the interest rate, the exchange rate, and the trade balance in response to each of the following shocks?

   a. The president raises taxes to reduce the budget deficit.

   b. The president restricts the import of Japanese cars.

2. Over the past several decades, investors around the world have become more willing to take advantage of opportunities in other countries. Because of this increasing sophistication, economies are more open today than in the past. Consider how this development affects the ability of monetary policy to influence the economy.

   a. If investors become more willing to substitute foreign and domestic assets, what happens to the slope of the *CF* function?